REP 1995-045

INTERNATIONAL JOURNAL OF PEST MANAGEMENT, 1995, **41**(1) 19–21

Evaluation of white plastic flags as visual repellents for Snow Geese on coastal salt marshes

(*Keywords: Chen caerulescens*, deterrent, flagging, goose)

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Abstract. Excessive grazing by Snow Geese (*Chen caerulescens*) causes severe damage to salt marshes along the eastern seaboard of the United States and to traditional agricultural practices such as salt hay farming. The effectiveness of white plastic flags as visual repellents to Snow Geese (*Chen caerulescens*) on six Delaware Bay salt hay (*Spartina* sp.) marshes was evaluated. At each site, two 20 ha plots were selected, and then randomly assigned to the treatment (1 flag/0·4 ha) or the control (1 bare stake/0·4 ha) condition. From November 1993 until April 1994, faeces were collected at weekly intervals along transects established in each plot. The mean dry weight of faeces in flagged plots was significantly less than the mean dry weight of faeces in control plots, indicating relatively lower levels of goose activity in flagged areas. These findings are consistent with growing evidence that plastic flags are a simple, economical method of repelling Snow Geese.

1. Introduction

Populations of Greater Snow Geese (*Chen caerulescens*) and reports of crop depredation by these birds are increasing throughout the eastern United States (Atlantic Flyway Council, 1981; Gauthier and Bedard, 1991). In addition to crop damage, excessive grazing by Snow Geese can cause severe damage to salt marshes (e.g. Kerbes *et al.*, 1990; Iacobelli and Jefferies, 1991; Hik *et al.*, 1992). Such damage has predictable negative impacts on traditional agricultural practices, such as salt hay farming, that occur in coastal areas. Unlike Canada Geese (*Branta canadensis*) that damage crops in the autumn (Heinrich and Craven, 1990), Snow Goose grazing is most severe in late February and early March during premigratory fattening (Ankney, 1977; Mason *et al.*, 1993).

Existing legal control strategies include hunting and harassment, and the use of auditory repellents/deterrents (Mason and Clark, 1994). None of these strategies is especially effective (Mason and Clark, 1994), and additional methods are being sought. One such method may be the use of flagging (Heinrich and Craven, 1990). During the winters of 1992–1993 and 1993–1994, the use of flagging and mylar as Snow Goose grazing deterrents in upland agricultural fields were evaluated. Mylar is a shiny, reflective tape that is red on one side and silver on the other. In both years, significant, long-lasting protection was achieved (Mason *et al.*, 1993; Mason and Clark, 1994). Given these results and similar findings in a small-scale test on a coastal marsh (Dewey, 1993), the present evaluation of flagging as a grazing deterrent on commercial salt hay meadows was undertaken.

2. Materials and methods

2.1. Study sites

Six commercial salt hay meadows were selected along the Delaware Bay in Cumberland County, New Jersey. Landowner reports and my personal observations indicated that all six meadows experienced severe grazing by Snow Geese during the winters of 1991–1992 and 1992–1993. The overwintering population of Snow Geese in Cumberland County during these two winters approached 30 000 birds (L. Widjeskog, New Jersey Div. Fish and Game, pers. commun.).

2.2. Flagging

Two 20·4 ha (50 acre) plots, separated by at least 1 km, were selected on each meadow. One plot was randomly selected for treatment, while the other was assigned to the control condition. For each treated plot, 50 rectangular white flags were constructed from plastic garbage bags (Acme Brand Large Kitchen Garbage Bags, dimensions 70×154 cm) stapled width-wise to 1·2 m lengths of wooden lathe. At the beginning of November, 1993, one flag was positioned in the centre of each acre (2·47 flags per ha), usually along the edge of a mosquito control ditch, tidal creek, or mudflat. The resulting grid of flagging was in accordance with (a) published recommendations for the use of flagging as waterfowl deterrents (Pfeifer, 1993); and (b) procedures followed during previous evaluations of white plastic flags as Snow Goose deterrents in upland contexts (Mason *et al.*, 1993; Mason and Clark, 1994). The flags stood approximately 0·9 m high. For each control plot, 1·2 m lengths of pine lathe were positioned as described for flags.

2.3. Procedure

Within each of the 12 plots, three transects were established between two randomly selected adjacent lathe stakes. The endpoints of each transect were marked by spraying the lathe with black paint. The length of each transect was measured using a Measure-master wheel (model no. MM30, Rolotape Corp., Spokane, Wash.). The mean transect length was $63{\cdot}3 \pm 3{\cdot}2$ m.

Data collection began on 10 November 1993, and continued until 6 April 1994. By the end of the test period, Snow Geese had migrated from the study area. During the trial, no other damage management technique was employed within any plot, although propane cannons were placed about 1·3 km from four plots (two flagged, two control) during the second and third weeks of March. These cannons probably had little effect on foraging behaviour. Observations suggest that subsequent to the hunting season, grazing geese along the Delaware Bay are unaffected by cannon reports at distances greater than 0·5 km (Mason, unpubl. obs.).

All plots were visited at 7-day intervals throughout the test. During each visit, observers walked the three transects and collected all goose droppings within 0·3 m of the midline of the transect. Sampling visits to each plot lasted approximately 60 min.

After collection, droppings were returned to the laboratory, placed in a drying oven at 37°C for 72 h, and then weighed. Weights were taken as measurements of goose activity within plots (e.g. Mason and Clark, 1994).

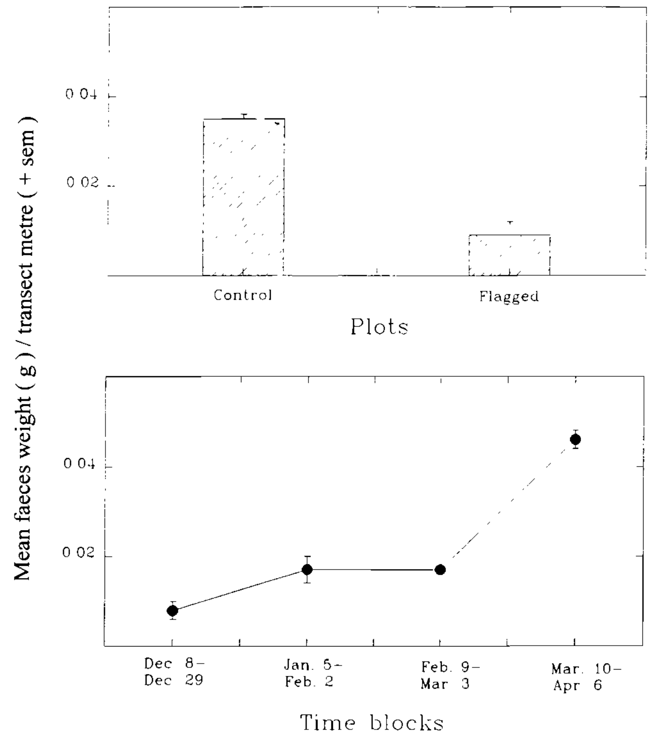

Figure 1. Top: mean faeces weight/transect metre collapsed over plot type during the four measurement blocks after December 8 1993. Bottom: Mean faeces weight/transect metre in flagged and control plots, collapsed over time blocks. Capped vertical bars represent standard errors of the means.

2.4. *Analysis*

Mean faeces weights/transect metre were calculated for each field on each sampling date, and then mean weights were calculated over 4-week blocks. Block means were assessed in a two-factor repeated measures analysis of variance (ANOVA, Keppel, 1973). The factors were time blocks and plots. Tukey *post-hoc* tests (Winer, 1962) were used to isolate significant differences among means ($P<0{\cdot}05$).

3. Results

The ANOVA was restricted to time blocks after 8 December 1993, because droppings were first located on that date. There were differences among time blocks ($F=12{\cdot}4$, 3,15df; $P<0{\cdot}0004$), and between plots ($F=48{\cdot}0$; 1,5df; $P<0{\cdot}002$). Otherwise, there were no significant effects ($P<0{\cdot}25$). Mean faeces weight/transect metre was significantly less in flagged areas than in control plots (Figure 1). Examination of the main effect for time showed that overall mean faeces weight/transect metre was greater during March than during December, January, or February.

4. Discussion and management implications

The present results confirm and extend previous findings. When alternative feeding sites are available, white plastic flags effectively deter grazing Snow Geese. The strategy is relatively easy to implement using all-terrain vehicles, and it is inexpensive. As an extreme example, the effective use of propane cannons requires one cannon for every 4 ha (10 acres, Mason and Clark, 1994). The average cost of a cannon (disregarding propane costs and maintenance) is $300·00 (Forestry Suppliers, Jackson, Miss., USA). The cost of using flags to protect the same area is about $8·00 ($0·80/flag).

One cautionary note is that the present results confirm other data which suggest that the effectiveness of flagging gradually diminishes as the time for migration approaches (Mason *et al.*, 1993; Mason and Clark, 1994). In the present case, birds began to enter flagged fields just prior to migration (i.e. mid-March) when food resources were (presumably) scarce, and the number of birds was increasing (L. Widjeskog, New Jersey Div. Fish and Game, pers. commun.). Such diminishing effectiveness is characteristic of visual repellent strategies (Feare *et al.*, 1986). In addition, it is clear that the effectiveness of any repellent strategy is partly a function of the amount of unprotected alternative forage available. As alternative foraging areas become smaller, repellents become correspondingly less effective. It is suggested that other deterrent strategies (propane cannons, harassment, pyrotechnics) should be implemented, as needed, to supplement flagging as a means of control.

Acknowledgements

Michael Coombes graciously permitted the use of his salt hay fields for the present experiment. Chris Boggs, Jessica Dewey, John Floyd, and Stanley Lewis provided valuable technical assistance. Funding was provided by US Department of Agriculture Cooperative Agreement 12-34-41-0040 [CA] between the Monell Chemical Senses Center and the Denver Wildlife Research Center (DWRC). All procedures were approved by the DWRC and Monell Animal Care and Use Committees.

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